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WATER SUPPLY AND WATER QUALITY CONTROL REQUIREMENTS ELEVEN POINT RIVER, ARKANSAS AND MISSOURI

Public Health Service
Dallas, Texas

November 1962

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DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service, Region VII
Dallas, Texas

In Cooperation with the

DEPARTMENT OF THE ARMY
U. S. Army Engineer District--Little Rock, Arkansas

NOVEMBER 1962

22

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DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
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I. INTRODUCTION

Authority

In a letter dated June 13, 1962, the U. S. Army Engineer District, Little Rock, requested the Public Health Service to ". . . make an investigation and report on the need for and advisability of including storage on the Eleven Point River for municipal and industrial water supply . . . ."

This study has been made in accordance with (1) the Water Supply Act of 1958 (Public Law 85-500, Title III) and a Memorandum of Agreement between the Department of the Army and the Department of Health, Education, and Welfare, dated November 4, 1958; and (2) the Federal Water Pollution Control Act (Public Law 84-660) as amended by Public Law 87-88.

Purpose and Scope

This report presents data and information pertinent to the determination of water requirements and corresponding benefits for the years 2020 and 2070 for municipal, industrial, and water quality control purposes in a seven-county area of Arkansas and Missouri, encompassing Eleven Point and surrounding river basins. Conclusions are based on projections of economic and demographic parameters within the study area.

Acknowledgments

Appreciation is expressed to the following organizations who gave counsel and technical advice during the preparation of this report.

Arkansas State Board of Health, Little Rock, Arkansas
Arkansas Water Pollution Control Commission, Little Rock, Arkansas
U. S. Army Engineer District, Little Rock, Arkansas
Arkansas Industrial Development Commission, Little Rock, Arkansas
Industrial Research and Extension Center, University of Arkansas, Little Rock, Arkansas

II. SUMMARY AND CONCLUSIONS

Summary

1. The Eleven Point River is a tributary to Spring River, which is in turn a tributary to the Black River. The Black River drains about one-third of the White River basin.

2. The study area encompasses two Arkansas counties and five Missouri counties. It is sparsely populated and has only five municipalities of over 1,000 persons--the largest having a 1960 population of 5,836. The total 1960 municipal population was 14,548.

3. Agriculture constitutes the largest single economic activity of the region and its principal output is livestock and livestock products.

4. Total 1958 municipal and industrial water use in the seven-county study area amounted to 2.14 million gallons per day (mgd); of this total 1.6 mgd was used by municipal centers (1,000 population or over).

5. The chemical quality of surface waters is excellent and suitable for municipal and industrial uses. Contributions by large springs provide a well-sustained dry weather flow. Ground water supplies are abundant and of good quality with the exception of moderate hardness in some localities.

Conclusions

1. The municipal population (people residing in the five cities and towns of over 1,000) for the entire seven-county study area is expected to reach 33,000 in 2020 and 65,000 in 2070.

2. Agriculture is expected to continue along trends of new technology and increased productivity resulting in more specialized crop and livestock programs and higher income from these sources. Mining is expected to continue at about the same level. Most of the people employed in manufacturing will continue to work in furniture and wood products and apparel.

3. Municipalities and industries of the area can meet their future water supply needs more economically from sources other than the Eleven Point River. Based on anticipated water supply needs, there is no benefit from storage in the proposed Corps of Engineers project.

4. The expected monthly distribution of mean annual low flows expected to recur once in 20 years is more than adequate to assimilate treated future waste discharges to rivers in the study area. Waste discharges resulting from municipal, industrial, and agricultural growth are not expected to be of the magnitude or type to measurably deteriorate stream quality. Based on expectations of the foreseeable future, there is no need for or benefit from storage in the proposed Corps of Engineers project for water quality control.

III. DESCRIPTION OF THE PROJECT AREA

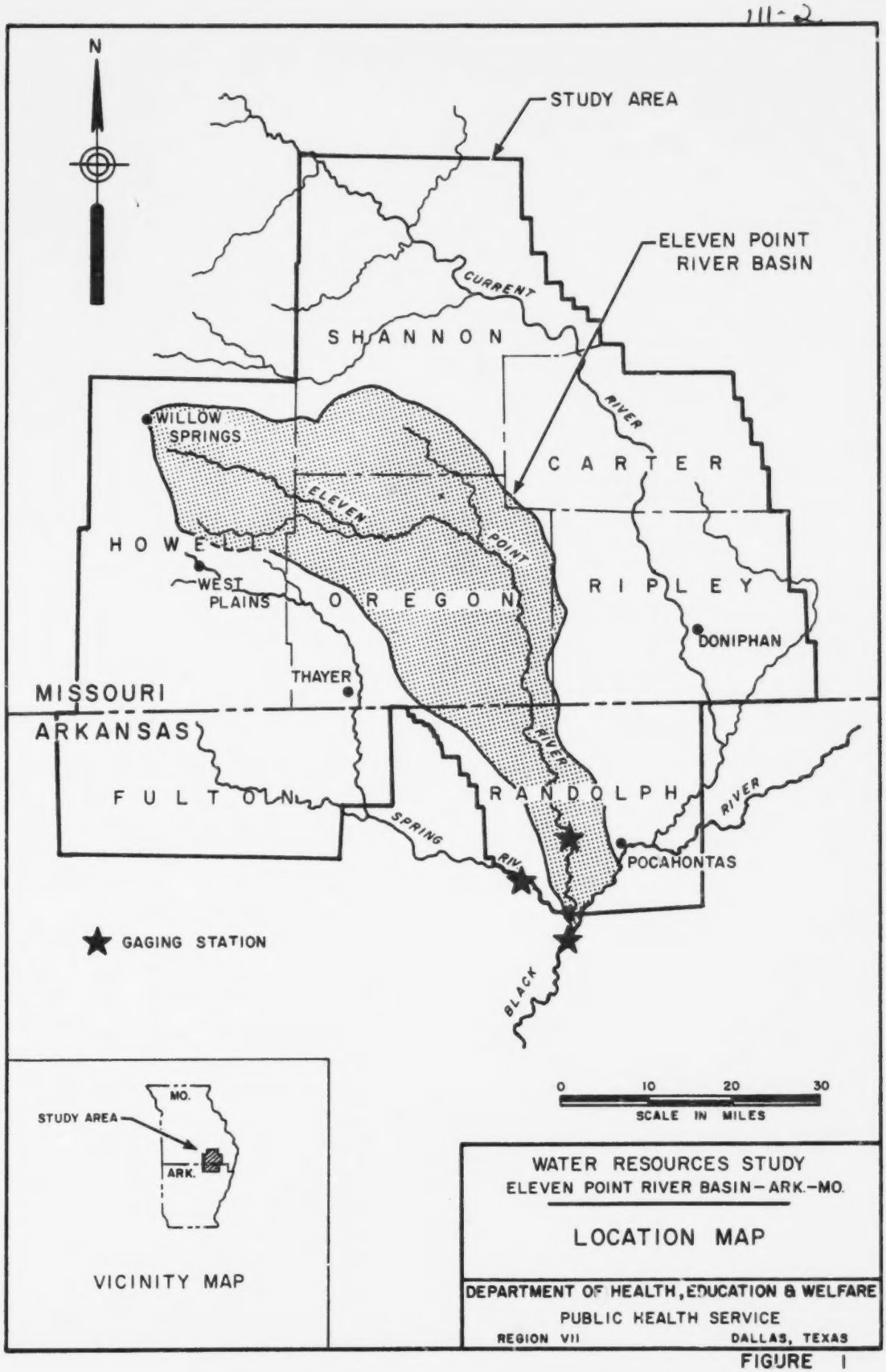
The study area encompasses two Arkansas and five Missouri counties. It was selected to represent that area which might reasonably be affected economically by water resources development in the Eleven Point River basin.

Figure 1 shows that Eleven Point River is a tributary to the Spring River which is in turn a tributary to the Black River. The Black River drains about one-third of the White River basin.

The area is rough country characterized by the mountains and highlands of the Ozark Plateau. The mean annual precipitation is 45 inches and the mean annual temperature is 59 degrees Fahrenheit. The growing season is about 240 days.

Surface waters are plentiful throughout the basin and contributions by large springs provide a well-sustained dry weather flow. Table VI-1 shows the chemical quality of surface waters is excellent.

Ground water supplies are abundant and of good quality [1/] with the exception of moderate hardness in some locations.



WATER RESOURCES STUDY
ELEVEN POINT RIVER BASIN – ARK.-MO.

LOCATION MAP

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REGION VII DALLAS, TEXAS

FIGURE 1

IV. ECONOMY OF THE STUDY AREA

An analysis of employment patterns for the years 1950 and 1960 reveals the overall economic picture of the seven-county study area. The most significant changes of employment were a decrease in agriculture accompanied by an increase in manufacturing and services. Although nearly all other categories increased during this decade, the loss of over 7,000 people employed in agriculture resulted in a decrease of the labor force. Employment data for 1950 and 1960 appear in Table IV-1.

Table IV-1

Study Area Employment, 1950 and 1960 [2/]

Industry	Labor Force 1950		Labor Force 1960	
	Number	Percent	Number	Percent
Agriculture	12,332	46.1	5,141	23.0
Forestry and Fisheries	126	0.5	111	0.5
Mining	46	0.2	143	0.7
Construction	1,356	5.1	1,355	6.1
Manufacturing	3,283	12.3	4,415	19.8
Service*	8,946	33.4	10,111	45.1
Unemployed	640	2.4	1,078	4.8
Labor Force	26,729		22,354	

*Service employment includes all noncommodity producing industries (wholesale and retail trade, services, government, and others).

About 2.3 million acres, or 70 percent of the study area, are covered by forests. Of these acres, over 90 percent are hardwoods. Although extensive use is made of hardwoods for flooring, furniture, veneers, poles, pilings, and cooperage, their existence does not encourage industrial development as do softwoods in connection with the pulp and paper industry.

The 1960 mineral production was valued at $800,000 (1954 dollars). The value of minerals produced varied from a low of $109,000 in 1953 to a high of $1,284,000 in 1957 as shown in Table IV-2. Extraction of brown iron ore accounted for most of this value. Higher grade ores have previously been extracted, but these deposits have been depleted.

Table IV-2

Value of Mineral Production in the Study Area [3/]
1953-1960
(1,000's of 1954 $'s)

1953	1954	1955	1956	1957	1958	1959	1960
109	221	405	774	1,284	853	945	800

Agriculture is the leading employment and income producing industry of the area. Although agricultural employment decreased 58 percent from 1950 to 1960, the value of farm products increased 49 percent (1954 dollars). Agricultural output for 1959 was valued at $22,750,000 as shown in Table IV-3. This information indicates higher productivity and advanced technological innovations such as new crop varieties and higher livestock feeding efficiencies. Over 75 percent of the agricultural income in 1959 resulted from the sale of livestock and livestock products.

Table IV-3

Agricultural Statistics of the Study Area [4/]
1944-1959

Year	No. of Farms	Acres of Cropland Harvested	Value of Products Sold (1,000's of 1954 $'s) Crops	All Livestock and Livestock Products	All Farm Products
1944	12,812	338,236	3,362	11,348	14,710
1949	12,453	291,406	4,725	10,585	15,310
1954	9,837	236,608	3,756	9,913	13,669
1959	8,165	211,330	5,293	17,457	22,750

Manufacturing employment increased 35 percent between 1950 and 1960 compared to a 16 percent increase in Missouri and a 32 percent increase in Arkansas. Manufacturing employment in 1960 accounted for 20 percent of the civilian labor force in the study area. The 1958 value added by manufacturing was $12,702,000 (1954 dollars). This was a large increase over 1939 and 1947 as shown in Table IV-4. Much of the manufacturing industry centers around furniture, lumber and wood products; and these account for 40 percent of the 1960 manufacturing employment. Other important manufacturing industries are apparel and food and kindred products.

Table IV-4

Value Added by Manufacturing
For the Study Area 5/
1939-1958
(1,000's of 1954 $'s)

Year	Value
1939	1,223
1947	2,498
1954	11,147
1958	12,702

The five communities in the study area with a 1960 population of 1,000 or more showed an annual growth rate of 1 3/8 percent between 1930 and 1960. The locations of these towns are shown in Figure 1. The largest of these towns is West Plains, Missouri, with a 1960 population of 5,836. The decline of total population shown in Figure 2 was due to a rural population loss accompanying the loss in the farm labor force. Historic populations for the study area appear in Table IV-5.

Table IV-5

Historic Populations for the Study Area
1930-1960 6/

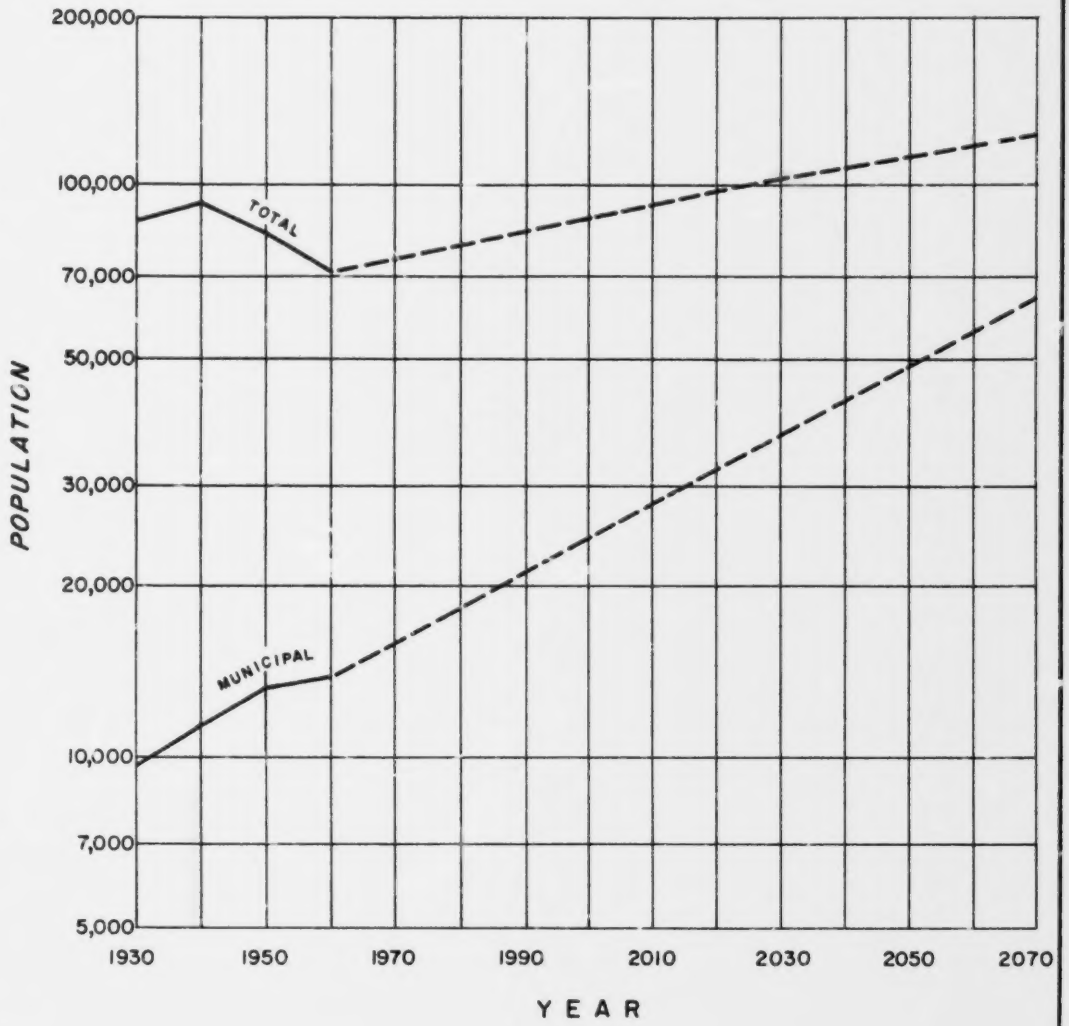
Year	Total Population	Municipal* Population
1930	87,170	9,691
1940	94,875	11,880
1950	84,444	13,922
1960	71,205	14,548

*In this report, municipal population refers to those cities and towns having a 1960 population of 1,000 or more people.

Future Growth

Future growth of this area will depend on its ability to compete with other areas in the United States in the production of goods and services.

Agriculture is expected to continue along trends of improved technology and increased productivity resulting in higher output from crop and livestock programs and higher income from these sources.



WATER RESOURCES STUDY
ELEVEN POINT RIVER BASIN—ARK.—MO.

POPULATION PROJECTIONS

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FIGURE 2

Continued growth in the livestock industry will occur as demands for livestock products increase as a result of expanding population and changing tastes of consumers. As shown in Table IV-6, agricultural employment is expected to be 4,000 people in 2020.

Although easily accessible deposits of iron ore have been depleted, production can be expected to increase slightly as a result of new surveys and new mining methods.

Manufacturing employment is expected to reach 8,680 in 2020. This represents 26.3 percent of the labor force. Most of the people employed in manufacturing will continue to work in furniture and wood products, apparel, and food and kindred products. Projections of employment appear in Table IV-6.

Table IV-6

Study Area Employment
1960 and 2020

Industry	Labor Force 1960 [3/]		Labor Force 2020	
	Number	Percent	Number	Percent
Agriculture	5,141	23.0	4,000	12.1
Forestry and Fisheries	111	0.5	150	0.5
Mining	143	0.7	200	0.6
Construction	1,355	6.1	1,550	4.7
Manufacturing	4,415	19.8	8,680	26.3
Service	10,111	45.1	17,100	51.8
Unemployed	1,078	4.8	1,320	4.0
Labor Force	22,354		33,000	

Total population is expected to reach 93,500 in 2020 and 130,000 in 2070 as depicted in Table IV-7 and Figure 2. These estimates are based on labor force projections previously described. Municipal population (people residing in the five cities and towns of over 1,000) is expected to reach 33,000 in 2020 and 65,000 in 2070. A summary of population projections appears in Table IV-7 and Figure 2.

Table IV-7

Study Area Population
1960, 2020, and 2070

Year	Total	Municipal
1960	71,205	14,548
2020	98,500	33,000
2070	130,000	65,000

V. WATER SUPPLY NEEDS

Figure 1 shows the five municipal centers of the study area. For purposes of this report, it is assumed that only these municipal centers would be potential users of water from the proposed Corps of Engineers project on Eleven Point River. Communities of less than 1,000 persons are not geographically located in a way that would permit the creation of water districts. Therefore, the cost of transporting water would necessarily limit the possibilities of smaller communities contracting for water from the proposed project.

The area's 1958 municipal water use amounted to an average of 1.6 mgd. This corresponds to an average daily per capita use of 120 gallons. All municipal water supplies were taken from wells except 0.5 mgd which was taken from the Black River.

Communities having less than 1,000 persons had a water use of 0.54 mgd in 1958 for an average of 120 gallons per capita day. Of this total use, 0.07 mgd was taken from Spring River and the remainder from ground water.

Municipal water uses of 1958 are shown in Table V-1.

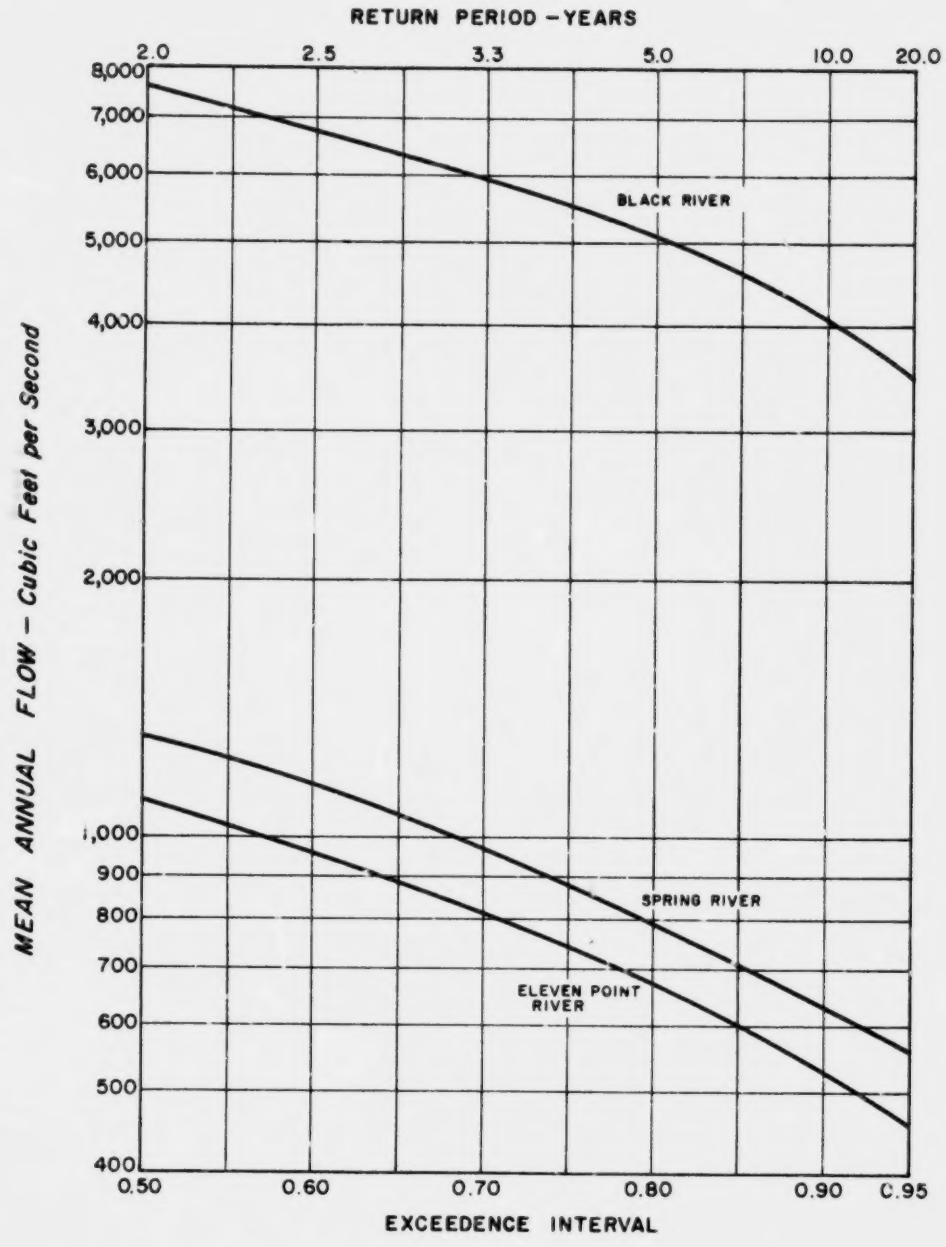
Table V-1

1958 Municipal Water Uses and Sources [7]

Municipality	Average 1958 Water Use (mgd)	Source of Water Supply
Doniphan, Mo.	0.10	2 wells rated at 1.0 mgd
Thayer, Mo.	0.30	2 wells rated at 0.75 mgd
West Plains, Mo.	0.60	4 wells rated at 1.87 mgd
Willow Springs, Mo.	0.10	2 wells rated at 0.29 mgd
Pocahontas, Ark.	0.50	Black River*
Total Municipal Use	1.60	

*See the flow duration curves of Figure 3.

Thayer and Doniphan are both about 26 miles from the proposed reservoir site. West Plains and Willow Springs are about 50 and 65 miles, respectively, from the proposed reservoir site. Considering the size of, and distance to, these municipalities and the availability of abundant ground water of good quality, [1] they are not expected to need storage on the Eleven Point River as a future water supply



WATER RESOURCES STUDY
ELEVEN POINT RIVER BASIN - ARK.- MO.

EXCEEDENCE INTERVAL
AND
RETURN PERIOD

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REGION VII DALLAS, TEXAS

FIGURE 3

source. Pocahontas, Arkansas, is located on and takes its water from the Black River. This river offers ample, high quality water and is expected to be a continuing source for Pocahontas.

The industries discussed in Section IV of this report are expected to be low water users and will probably be supplied by public water supplies. Since municipalities and industries of the area can meet their future water supply needs more economically from sources other than Eleven Point River, no benefit is anticipated for storage in the proposed Corps of Engineers project for expected water supply needs.

VI. WATER QUALITY CONTROL

Eleven Point River discharges into the Spring River about two miles above its confluence with the Black River. Abundant water of good quality is available in the Eleven Point and surrounding river basins. Table VI-1 shows relative chemical constituents of Eleven Point, Black, and Spring Rivers. The samples were taken in the period from October 1952 through September 1957.

Eleven Point River has a mean annual flow of 460 cfs even at the 95 percent exceedence interval. Corresponding flows of Black and Spring Rivers are 3,500 cfs and 560 cfs, respectively. Figure 3 shows exceedence intervals, return periods, and corresponding flows for Eleven Point, Black, and Spring Rivers. Table VI-2 shows how mean annual flows at various probability levels are expected to be distributed by months.

Table VI-2 shows that Eleven Point River is expected to have a mean monthly flow of 252 cfs during September, October, and November, based on the mean annual low flow that is expected to recur once every 20 years. Corresponding flows in Spring River are expected to be 216 cfs (September), 216 cfs (October), and 324 cfs (November). These flows are high enough not to be measurably degraded by adequately treated, future waste discharges.

The low mean monthly flow in Black River, below its confluence with Spring River, is expected to be 1,524 cfs. This is based on the monthly distribution of a mean annual low flow which will recur once in 20 years. This flow is also great enough to assimilate adequately treated, future waste discharges without measurable quality degradation.

Table VI-1 shows that water in Eleven Point, Black, and Spring Rivers is of very high quality. Waste discharges resulting from municipal, industrial, and agricultural growth are not expected to be of the magnitude or type to measurably deteriorate stream quality.

The 95 percent exceedence interval has been selected as an extreme mean annual low flow for this report. It can be seen from Table VI-2 that expected low flows for less severe recurrence intervals will be less affected by expected future waste discharges.

Since waste discharges from future development are not expected to markedly deteriorate water quality, there is no expected need for or benefit from storage for water quality control in the proposed project.

Table VI-1

Chemical Quality of Eleven Point, Black, and Spring Rivers[8/]

River	No. Samples	Total Dissolved Solids (mg/l)			Chloride (mg/l)			Sulfate (mg/l)			Nitrates (mg/l)		
		Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.
Eleven Point	78	230	187	60	6.5	2.3	1.0	13.0	4.1	0.6	4.9	2.4	0.3
Black	78	203	142	38	8.0	3.0	1.8	18.0	4.7	2.2	6.2	1.9	0.3
Spring	74	247	192	81	7.5	2.7	0.5	9.2	4.8	1.0	5.4	2.3	0.1

Table VI-2

Monthly Distribution of Mean Annual Flows Having Exceedence Intervals of 80, 90, and 95 Percent
(cubic feet per second)

	Eleven Point R.			Black River			Spring River		
	80%	90%	95%	80%	90%	95%	80%	90%	95%
Jan.	684	540	468	5,904	4,740	4,044	852	684	612
Feb.	756	600	528	6,840	5,496	4,692	1,200	972	864
March	1,044	828	720	8,820	7,092	6,060	1,308	1,056	948
April	1,080	852	744	9,528	7,644	6,540	1,344	1,080	960
May	1,008	804	696	7,608	6,120	5,220	1,308	1,056	936
June	828	648	564	4,836	3,888	3,324	744	600	540
July	564	444	384	3,528	2,832	2,424	528	432	384
Aug.	444	348	300	2,640	2.112	1,812	372	300	276
Sept.	372	300	252	2,220	1,788	1,524	312	252	216
Oct.	372	300	252	2,268	1,824	1,560	300	240	216
Nov.	372	300	252	3,132	2,520	2,148	444	360	324
Dec.	516	396	360	3,876	3,144	2,652	648	528	444
Mean Annual	670	530	460	5,100	4,100	3,500	780	630	560

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